

AND THE HEIGHT IS?

Suggested Grades

9th or 10th Grade Geometry

SD Mathematics Strand & Standard (Primary for Task)

Geometry

9-12.G.2.3 Students are able to use proportions to solve problems.

Task Summary

Students demonstrate their understanding of proportion and the properties of similar right triangles to determine the height of intersecting cable lines.

Time and Context of Task

1 class period.

Use this task after studying similar triangles and reviewing how to solve a system of equations. This task can be used as a group activity or as an individual activity.

Materials Needed

Paper, Pencil, Calculator or Graphing Calculator

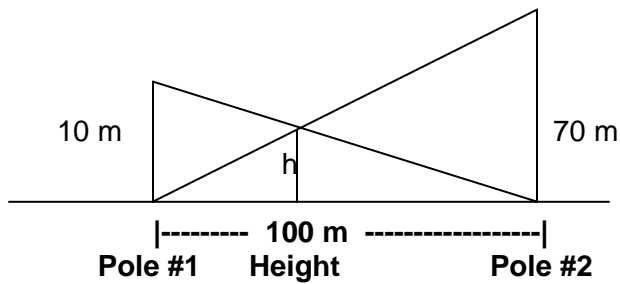
Author and Lead Teacher for This Task

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You are an employee for a local utility company. You have been given the task of finding the height of the intersection of the two cables joining the top of two telephone poles to the foot of the opposite pole. Each telephone pole and cable, along with the ground, form a right triangle. The poles you observe are respectively 10 meters and 70 meters tall and are 100 meters apart. Using these specifications, prepare a presentation of your calculations and present your findings to your supervisor. A picture that illustrates the information above is shown below.



CONTENT STANDARDS

Primary Standard

Strand Name: Geometry

SD Goal: Students will use the language of geometry to discover, analyze, and communicate geometric concepts, properties, and relationships.

Indicator 2: Use properties of geometric figures to solve problems from a variety of perspectives.

Standard: 9-12.G.2.3 Students are able to use proportions to solve problems.

Supplemental Standard

Strand Name: Algebra

SD Goal: Students will use the language of algebra to explore, describe, represent, and analyze number expressions and relations that represent variable quantities.

Indicator 2: Use a variety of algebraic concepts and methods to solve equations and inequalities.

Standard: 9-12.A.2.3A Students are able to determine the solution of systems of equations and systems of inequalities.

NCTM Process Standards

Communication: Use the language of mathematics to express mathematical ideas precisely.

Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

Connections: Recognize and apply mathematics in contexts outside of mathematics.

Problem-Solving Strategies

Drawing pictures, graphs, and tables

ASSESSMENT TOOLS

Task Rubric

	Advanced	Proficient	Basic	Below basic
9-12.G.2.3 Students are able to use proportions to solve problems.	Student is able to solve a system of equations derived from proportions involving overlapping similar right triangles.	Student is able to set up more than one proportion using similar right triangles to solve the problem.	Student is able to recognize similar right triangles and is able to set up and begin to solve a proportion using them.	Draws no conclusion or draws an invalid conclusion from the problem.
Use of Proportions and Systems of Equations to Solve the Problem	Accurate, reasonable, justified, and properly labeled.	The majority of the solution is accurate, reasonable, and complete.	Some evidence of an attempt made to come up with a solution.	No evidence or no attempt made to find a solution.
Communicate Mathematically	Clearly and consistently uses language that is mathematically correct.	Uses clear language that frequently includes appropriate mathematical terminology.	Uses language that sometimes is mathematically correct.	Uses vague language that does not use mathematical terminology.
Convincing Presentation	Presentation shows complete understanding of the mathematical concepts used. It is organized, clear, and convincing.	Presentation shows substantial understanding of the mathematical concepts used. Some organization but not very convincing.	Presentation shows some understanding of the mathematical concepts used. Very little organization. Conclusions are not convincing.	Presentation shows very limited understanding of the underlying concepts needed or no attempt to convince.

**Core High School Geometry
Performance Descriptors**

Advanced	High school students performing at the advanced level: <ul style="list-style-type: none"> • translate and reflect a figure using the coordinate plane; • supply a missing reason and/or statement in a deductive proof.
Proficient	High school students performing at the proficient level: <ul style="list-style-type: none"> • use deductive reasoning and known properties of a geometric figure to find other properties; • use proportions to solve problems; • translate or reflect a simple figure using the coordinate plane; • match a two-dimensional drawing to its three-dimensional counterpart.
Basic	High school students performing at the basic level: <ul style="list-style-type: none"> • identify a translation or reflection; • solve a proportion.

**Core High School Geometry
ELL Performance Descriptors**

Proficient	High school ELL students performing at the proficient level: <ul style="list-style-type: none"> • represent and solve problems involving perimeter, circumference, area, and volume (i.e. volume of a box) of common geometric figures in word problems; • use deductive reasoning and known properties of a geometric figure to find other properties; • use proportions to solve problems; • translate or reflect a simple figure using the coordinate plane; • match a two-dimensional drawing to its three-dimensional counterpart; • read, write, and speak the language of geometry and apply it to geometry problem-solving situations.
Intermediate	High school ELL students performing at the intermediate level: <ul style="list-style-type: none"> • use geometry concepts; • use formulas to calculate perimeter, circumference, and area of common geometric figures in word problems given oral support; • use geometric terms in explaining solutions orally; • explain in geometric terms the sequence of steps and/or strategies used in problem solving; • give oral, pictorial, symbolic (diagrams) or written responses to questions on topics presented in class.

AND THE HEIGHT IS?

Student Work Samples

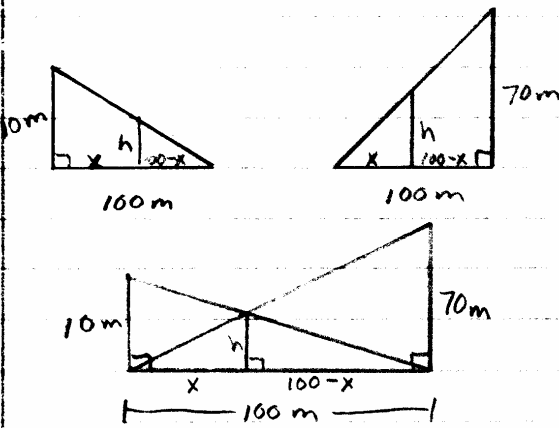


As you examine the samples, consider the following questions:

- In light of the standard/s addressed and the assessment tools provided, what evidence does the work provide that students are achieving proficiency in the knowledge and skills addressed by the standard/s for the task?
- Is the task/activity well designed to help students acquire knowledge and demonstrate proficiency? Is the task/activity clearly aligned with the standards? In what ways would you adapt the task/activity to better meet the needs of your students?

Student #1 Work Sample

Work Sample



The student has drawn three diagrams illustrating the problem. The first diagram shows a right triangle with a vertical leg of 10m, a horizontal leg of x, and a hypotenuse of 100m. The second diagram shows a right triangle with a vertical leg of 70m, a horizontal leg of 100-x, and a hypotenuse of 100m. The third diagram shows two overlapping right triangles sharing a common vertical leg of height h. The base of the first triangle is x and the base of the second triangle is 100-x. The total base is 100m. The vertical legs are 10m and 70m.

$$\frac{h}{70} = \frac{x}{100} \quad \frac{h}{10} = \frac{100-x}{100}$$

$$100h = 70x \quad 100h = 1000 - 10x$$

$$70x = 1000 - 10x$$

$$80x = 1000$$

$$x = \frac{1000}{80} = \frac{25}{2}$$

$$100h = 70\left(\frac{25}{2}\right)$$

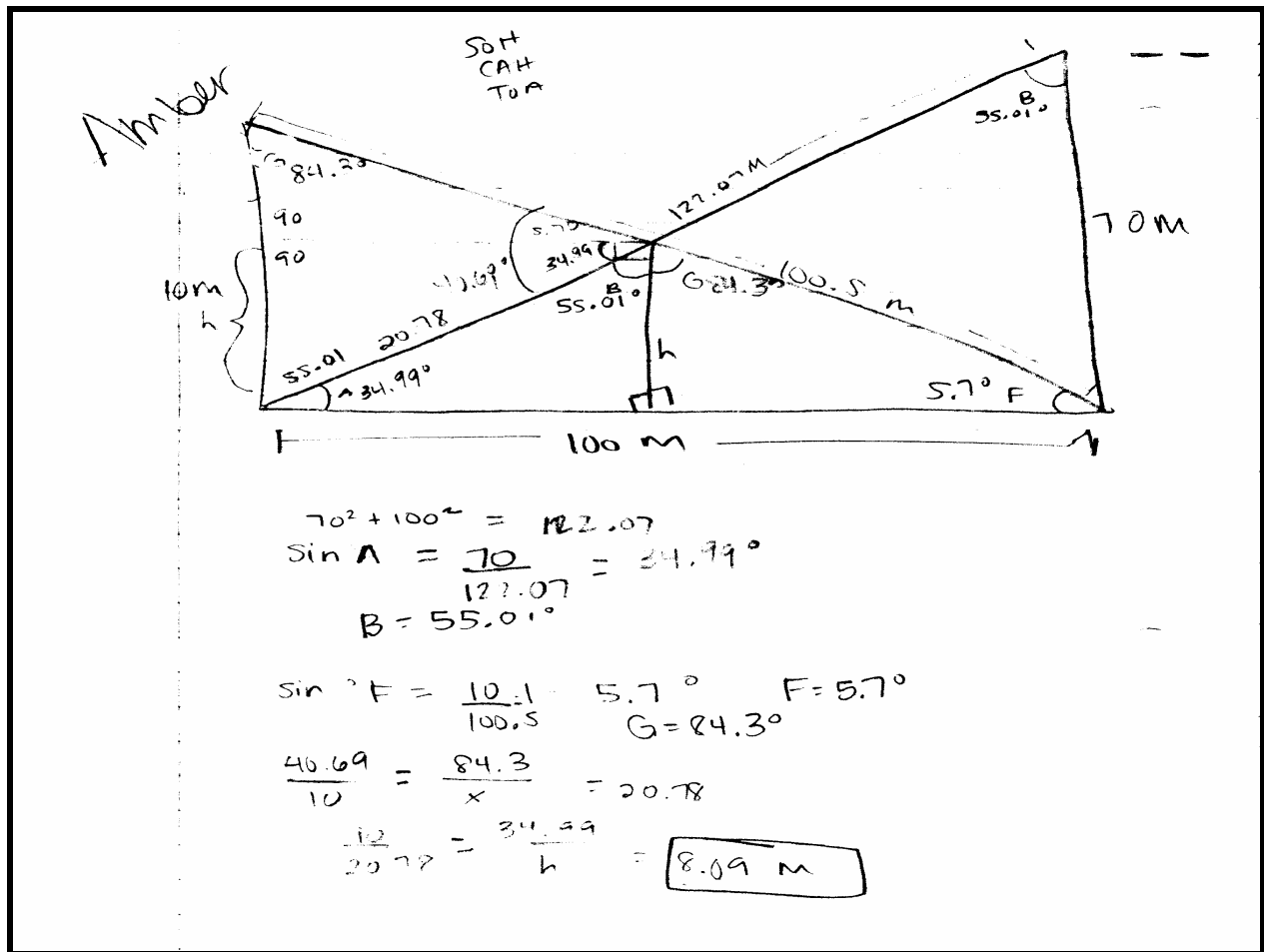
$$100h = 875$$

$$h = \frac{875}{100} = 8.75 \text{ m off ground}$$

Looking at Student Work – Instructor notes and rating for work sample #1:

Based on the assessment rubric, I would rate this student as being advanced. The student is able to set up and correctly solve a system of linear equations derived from overlapping similar triangles. The student is definitely proficient according to the core geometry standard (9-12.G.2.3) but also exhibits the ability to be considered advanced when it comes to the supplemental algebra standard (9-12.A.2.3A) which is an advanced standard.

Student #2 Work Sample



Looking at Student Work – Instructor notes and rating for work sample #2:

I would rate this student as being basic based on the assessment rubric. The student is able to solve a proportion but chooses to work the problem with the Pythagorean Theorem and right triangle trigonometry (most values are correctly approximated). The student makes a couple of incorrect assumptions in terms of distances.

INSTRUCTIONAL NOTES

Author Comments

The application of similar triangles is a topic that is covered late in the first semester in our curriculum. To get student samples in a timely manner this task was given to students who had completed geometry and who were currently in the first semester of advanced algebra.

Task Extension

A picture does not necessarily have to be given to the students if you want to make the problem more difficult.

Common Strategies

Students who were the most successful separated the overlapping triangles (pulled them apart) before setting up proportions.

Appropriate Technology

Graphing Calculator
TI-Connect Software

Resources

SD Mathematics Content Standards

<http://www.doe.sd.gov/contentstandards/math/index.asp>

SD Assessment and Testing

<http://www.doe.sd.gov/octa/assessment/index.asp>

The National Assessment of Educational Progress (NAEP)

<http://www.doe.sd.gov/octa/assessment/naep/index.asp>

National Council of Teachers of Mathematics

<http://nctm.org/>

Looking at Student Work

<http://www.lasw.org/index.html>